

New Zealand Cormorants in the collection of the Auckland Museum, with notes on field observations.

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(Plates 25-27.)

Lack of sufficiently large and complete series and of reliable field data have hampered all reviewers of the New Zealand *Phalacrocoracidae*. Two recent works, those of Alexander (1928) and Oliver (1930), discuss briefly the relationships of the forms and reach differing conclusions regarding the status of the sub-antarctic forms particularly.

The present paper is mainly descriptive and is based on 81 New Zealand specimens in the collection of the Auckland Museum. Lack of reliable data with many of the older specimens, especially from the sub-antarctic region, and absence of juvenile series in some species, render it inadvisable to discuss relationships at any length, but the records of distribution and variation obtained should make a further contribution to the exact data so necessary for an adequate review of New Zealand cormorants.

For this reason tables of measurements in millimetres have been included under each species discussed. The measurement of the bill has been made in each case with dividers, and represents the chord of the exposed culmen. Other dimensions are also the shortest distance between extreme points, except in the measurement of the wing, where the primaries have been flattened along the rule.

Field observations have been recorded here only where necessary to supplement the existing literature.

Genus *PHALACROCORAX* Brisson.

Phalacrocorax carbo (Linne).

Pelecanus carbo Linne, Syst. Nat., 10th Ed., 133, 1758. Type locality: Sweden.

Carbo carbo steadi, Mathews and Iredale, Ibis 10th series, vol. 1, 1913, p. 411: New Zealand.

Material examined in the collection of Auckland Museum.

| No. | Sex. | Locality. | Date. | Wing. | Tail. | Tarsus. | Outer Toe. | Bill. |
|--------|----------|----------------|---------|-------|-------|---------|---------------|-------|
| 105.1 | immat. ♀ | Otago | — | 370 | 167 | 60 | 98 | 66 |
| 105.2 | ad. ♀ | Waikato | — | 341 | 152 | 54 | 89 | 61 |
| 105.3 | ad. ♂ | Motutara | 1922 | 346 | 155 | 60 | 99 | 61 |
| 105.4 | immat. ♂ | Motutara | — | 357 | 154 | 63 | 101 | 65 |
| 105.5 | ad. ♂ | Motutara | — | 355 | 157 | 62 | 101 | 63 |
| 105.8 | ad. ♂ | Bay of Islands | — | 340 | 150 | 58 | 95 | 60 |
| 105.9 | ad. ♂ | Waikato | 2/11/31 | 357 | 150 | 64 | 103 | 68 |
| 105.11 | ad. ♀ | Bay of Islands | 25/8/30 | 340 | 165 | 52 | 100 | 61 |
| 105.13 | ad. ♂ | Waikato | 2/11/31 | 357 | 154 | 60 | 102 | 67 |
| 105.14 | ad. ♂ | Tamaki River | 5/16 | 340 | 150 | 55 | 91 | 59 |

In describing the New Zealand black shag as *Carbo carbo steadi*, Mathews and Iredale state (1913, p. 411) that it "is easily separable from the typical *C. c. carbo* by the scant white neck feathers of the summer plumage as well as by size; compared with *C. c. novae-hollandiae*, the nearest breeding subspecies of *C. c. carbo*, it is smaller in every dimension. Average measurements *C. c. novae-hollandiae*: culmen 66 mm., wing 345; average measurements *C. c. steadi*: culmen 59 mm., wing 325."

The series tabulated above gives a higher average for both dimensions, viz., culmen 63 mm., wing 350. Nuptial ornamentation is admittedly of short duration, but when fully developed hardly justifies the description "scant." As a contribution to future comparative studies of the forms of *P. carbo* a photograph is here given (Pl. 25, fig. 1) of the head of No. 105.14.

Breeding observations:—Black Shags breed twice a year, laying in May and September. Nuptial plumes would appear to be assumed before both the spring and autumn breeding seasons, for they occur in both August and May birds in the above series. However, among a colony of 35 pairs with fresh eggs in May, observed in 1930 in the Wellington district, not one showed nuptial ornamentation, and only one bird had white thigh patches, showing that either the extra plumes are shed very rapidly or under some circumstances are not assumed at all.

Sub-genus *MESOCARBO* Mathews and Iredale.

Phalacrocorax (Mesocarbo) ater (Lesson).

Carbo ater Lesson, Traite d'Orn., 8, 604, 1831.

Type locality: Shark Bay, West Australia.

Material in Auckland Museum Collection:—

| No. | Sex. | Locality. | Date. | Wing. | Tail. | Tarsus. | Outer Toe. | Bill. |
|--------|-------|----------------|---------|-------|-------|---------|---------------|-------|
| 162.1 | ad. ♂ | Bay of Islands | — | 239 | 118 | 45 | 73 | 47 |
| 162.2 | ad. ♂ | Bay of Islands | — | 260 | 122 | 45 | 80 | 49 |
| 162.3 | ad. ♂ | Bay of Islands | — | 257 | 136 | 44 | 76 | 49.5 |
| 162.4 | ad. | Bay of Islands | — | 237 | 125 | 38 | 74 | 44 |
| 162.5* | juv. | Lake Waikare | 2/11/31 | 198 | 92 | 43 | 82 | 47 |

*Pl. 25, fig. 2.

The most interesting specimen in the above series is No. 162.5, a bird not quite fully fledged. Not only is this the first recorded young specimen of the little black shag in New Zealand, but its discovery extends the known breeding range of the species southward by some two hundred miles. It is appropriate that the credit for collecting the bird should belong to Mr. A. T. Pycroft, to whose researches at the Bay of Islands we owe practically all that is recorded of the habits of this shag in New Zealand, and all the specimens in Museum collection. Lake Waikare, in the lower Waikato, is a large fresh water lake surrounded by swamp. The large colonies of shags (mainly *P. carbo*) that nest in the kahikatea trees growing in the swamp are visited annually by shooting parties, who endeavour to destroy the birds in the supposed interests of trout fisheries. In order to obtain specimens, Mr. Pycroft accompanied one such party in November, 1931. Although many birds were shot, he was able to retrieve only three, one of them being the young of *P. ater*. This bird was evidently shot on the nest, for neither wings nor tail are fully grown. Short sooty black down covers the entire body except the face and crown, which are naked, and the wings and scapulars, which are well developed and of the same colour as the adult plumage. The irides were brown, bill and facial skin purple grey, and feet black.

Sub-genus MICROCARBO Bonaparte.

Phalacrocorax (Microcarbo) brevirostris Gould.

Phalacrocorax brevirostris Gould P.Z.S., 1837, p. 26.

Type locality: New Zealand.

Material examined in collection of Auckland Museum:—

| No. and Sex. | Locality. | Date. | Outer | | | | |
|--------------|-----------------|----------|-------|-------|---------|------|-------|
| | | | Wing. | Tail. | Tarsus. | Toe. | Bill. |
| 92.1 ♀ | Lake Waitakerei | — | 235 | 155 | 36 | 66 | 30 |
| 92.2 ♂ | Dunedin | — | 233 | 156 | 36 | 68 | 32 |
| 92.4 ♀ | Lake Waitakerei | — | 234 | 150 | 35.5 | 64 | 30 |
| 92.5 ♀ | Lake Waitakerei | — | 223 | 162 | 35 | 64 | 30 |
| 92.6 ♀ | Whangaparaoa | 27/8/96 | 225 | 155 | 36 | 66 | 29.5 |
| 92.21 ♀ | Pokeno | 5/07 | 230 | 158 | 36 | 65 | 29 |
| 92.24 immat. | Bay of Islands | — | 230 | 140 | 34 | 63 | 30.5 |
| 92.25 ♂ | Mercer | 2/11/31 | 228 | 150 | 37 | 67 | 29.5 |
| 92.26 | Kereu River | 16/11/31 | 212 | 153 | 35 | 64 | 30 |
| 98.1 ♂ | Lake Waitakerei | — | 240 | 166 | 36 | 66 | 30.5 |
| 98.2 ♀ | Whangarei | 17/8/78 | 223 | 143 | 35 | 62 | 30.5 |
| 98.3 ♀ | Lake Waitakerei | 11/80 | 230 | 152 | 35 | 68 | 29.5 |

Noticeable features of the above series are the remarkable uniformity in the size of all the birds and the colours of soft parts, and the still more remarkable variation in the disposition of black and white in the plumage. No. 92.23, a nestling not listed above, is half-fledged. Apart from the half grown wings and tail and the bare face, the body is clothed in dark fuscous

down. The small tufts of white down along the anterior margin of the wings, mentioned by Buller (1888, p. 172) are also noticeable.

No. 92.24 is an all-dark yearling bird. Head, neck and breast are strongly tinged brown, and the throat feathers are brownish grey.

No. 92.21 has a white throat extending up to the level of the gape. There are plentiful white filoplumes in the neck and a brown tinge throughout the plumage suggesting immaturity.

Nos. 92.1, 92.2 and 92.4 exhibit the facial pattern shown in Plate 26, fig. 1, right, with black ear coverts.

Nos. 92.5, 92.6, 92.25, 92.26 have the head identical with the "little pied" form (Plate 26, fig. 1, left). The white extends irregularly down to the upper part of breast in 92.5 and 92.6.

No. 98.1 agrees with descriptions of the plumage of *P. melanoleucus* (Vieillot) except for scattered black feathers in the thighs.

No. 98.3 just fails to reach the "little pied" condition by having black thighs and a few black feathers on chest and abdomen.

No. 98.2 (Plate 26, figs. 2, 3) is remarkable for the extreme development of white plumage. That it belongs to *P. brevirostris* stock, at least in part, is evident from the thin line of black across the breast. Whatever subsequent investigation discloses with regard to the status of short-billed shags there is no doubt that a strong tendency to whiteness must always be reckoned a factor.

As none of the above can be exactly referred to *P. melanoleucus* (Vieillot) they are here all included under *P. brevirostris* Gould. As the writer has not had an opportunity to examine good series of the supposed *P. melanoleucus* he prefers to make no comment on its status in New Zealand.

Opinion has oscillated as to the status of the small shags of this sub-genus found in New Zealand. Buller (1888, p. 169, and later 1905, p. 43) inclines to the opinion that *P. brevirostris* exhibits a strong tendency to albinism, and that its colours may approximate to the condition of the Australian species *P. melanoleucus* (Vieillot). He admits *P. melanoleucus* as a separate species on specimens exhibiting the frilled condition, due to frontal crest and elongated white feathers on the side of the head. As this condition also occurs in birds of the "white-throated" form (Plate 26, fig. 1, left) this distinction is not tenable. Until recently the published data indicated, although rather imperfectly, that all New Zealand birds were separable from *P. melanoleucus* (Vieillot), as a subspecies with a strong tendency to albinism, and the series here discussed confirms that view.

Oliver (1930, p. 184) has made a good case for the recognition of two species of short-billed shags, *P. melanoleucus* and *P. brevirostris*, and holds that they sometimes cross, producing hybrids of intermediate plumage. In support of this he refers to immature specimens which he examined in Canterbury, in which

the undersurface is mottled brown and white. There would seem on the present specimens available no alternative to the conclusion that two or more forms of short-billed shags are recognisable and that they interbreed, but this appears to be the interbreeding merely of phases of a dimorphic or polymorphic species, a condition paralleled in some species of Tubinares, for example, *Puffinus pacificus*. Unfortunately no description exists of the nestling down, and first juvenile plumage of the supposed *P. melanoleucus* in New Zealand. The writer has had under observation during the last few years in two localities nests that were destroyed by shooting parties before the eggs hatched.

Habits:—Some observations made by the writer at Slipper Island, Bay of Plenty, on 31st January, 1926, relate to the segregation of the two extreme phases. Associated with a large nesting colony of *Phalacrocorax varius* in pohutukawa trees (*Metrosideros tomentosa*) were four smaller nests containing well grown nestlings with naked heads and uniform dark fuscous down. These were attended and fed by four pairs of "white-throated" birds. In the next tree were three nests of similar size on which "little pied" birds were sitting, mates in similar plumage perching nearby. The nests contained fresh eggs (three in each). These adult "little pied" birds were crested and "frilled," and all six had odd black feathers scattered on lower abdomen and thighs.

Food:—Interesting information as to the food of this species is published by the Marine Department of New Zealand in the report of the Chief Inspector of Fisheries (Hefford, 1931, pp. 27-28). Ten specimens, including both forms, were collected from the tidal estuaries of the Kaipara Harbour on 14th September, 1929. Their stomach contents are listed and include crustacea and fish in equal proportion, with indications that the birds favour fresh water. The stomach of No. 92.25, in the Museum series, shot on the Waikato River at Mercer, contained about ten fresh-water crayfish.

Sub-genus *HYPOLEUCUS* Reichenbach.

Phalacrocorax (Hypoleucus) varius (Gmelin).

Pelecanus varius Gmelin, Syst. Nat., 1, 576, 1789.

Type locality: Queen Charlotte Sound.

Material examined:—

| Collection and Number. | Sex. | Locality. | Date. | Wing. | Tail. | Tarsus. | Outer Toe. | Bill. |
|------------------------|--------|----------------|---------|-------|-------|---------|------------|-------|
| Auck. Mus. 100.1 | ad. | Whangarei | — | 295 | 140 | 59 | 91 | 66 |
| Auck. Mus. 100.2 | juv. ♀ | Whangaparaoa | 27/8/96 | 278 | 140 | 57 | 90 | 61 |
| Auck. Mus. 100.4 | ad. ♂ | Whangarei | 21/8/78 | 295 | 133 | 69 | 102 | 69 |
| Auck. Mus. 100.5 | juv. ♂ | Orakei | 1/10/78 | 280 | 130 | 57 | 88 | 59.5 |
| Auck. Mus. 100.6 | juv. ♂ | Whangaparaoa | 6/9/96 | 309 | 160 | 65 | 99 | 72 |
| Auck. Mus. 100.7 | juv. ♂ | Whangaparaoa | 6/9/96 | 305 | 143 | 62 | 97 | 70 |
| Auck. Mus. 100.8 | juv. | Hauraki Gulf | — | 305 | 150 | 62 | 96 | 70 |
| Auck. Mus. 100.9 | ad. ♂ | Hen Island | 26/1/32 | 275 | 125* | 50 | 85 | 59 |
| Auck. Mus. 100.10 | juv. ♂ | T. Bowling Bay | 15/2/32 | 300 | 135 | 56 | 93 | 71 |
| R.A.F. 54 | ad. ♀ | Auck. Harbour | 21/4/24 | 278 | 147 | 56 | 82 | 57 |
| R.A.F. 17 | ad. ♀ | Hauraki Gulf | 15/5/22 | 274 | 127 | 56 | 92 | 58 |
| R.A.F. 32 | ad. ♀ | Auck. Harbour | 21/6/24 | 280 | 126 | 58 | 94 | 60 |

*Tail much worn.

The dimensions tabled above indicate a characteristic of this species that is evident in field observations, namely, the variation in size. This has nothing to do with age, nor, apparently, with locality. A size variation in the sexes is, however, suggested by the fact that the average bill measurement of 5 males in the above is 68.3 mm., and of 4 females 59 mm. No. 100.9 is an albino specimen, pure white except for light brown flanks and thighs and a faint stain of brown on hind neck, scapulars and rump. The irides were dull hazel, facial skin flesh colour except for yellow patch in front of the eye; feet brown.

Colours of the soft parts of a normal specimen, an adult female shot on May 30th, 1932, were—smooth loreal patch primuline yellow; irides sea green; fleshy ring surrounding the eye viridine green changing to blue near the gape; gape tinged yellow; gular pouch fleshy mauve; bill pale horn, brown on ridge; feet black.

Sub-genus *LEUCOCARBO* Bonaparte.

The cormorants inhabiting high southern latitudes and grouped in three areas, namely, South America and its sub-antarctic quadrant, the South Indian Ocean, and the sub-antarctic coasts and islands of New Zealand, are generally regarded as distinguishable from other cormorants by well-marked external characters shared by most of them. These characters are the fleshy ring of blue skin surrounding the eye, the frequent presence of dorsal and alar patches of white feathers, the brightly metallic plumage of the upper parts and flesh-coloured feet. This last point, the colouration of the feet, has been a source of much confusion in descriptions, and most published coloured plates are unreliable in this respect. It would now appear that the feet of blue-eyed shags are all some shade of pink in life. It has recently been accurately reproduced by L. H. Mathews (1929, pl. XLVII.) in the case of *P. georgianus*. In dried skins the feet of all the species I have examined dry to a rich orange brown, which is perhaps responsible for the frequent occurrence of "feet orange" in descriptions. Literature of this group by various writers during the nineteenth century is not always reliable, on account of inaccurate determination and lack of comparative material, a disadvantage that still persists to some extent. Hutton (1905) reviewed the New Zealand forms and discussed relationships. Mathews and Iredale (1913) summarise their conclusions in a reference list. Murphy (1916) has discussed the American sub-antarctic forms, giving much valuable field data which can be applied comparatively in a study of other areas, and lately Oliver (1930) has summarised the available information to that date on all New Zealand cormorants. In the following comment is made on all New Zealand forms with the exception of *P. colensoi* and *P. ranfurlyi*, of which there are no specimens in the Auckland Museum collection.

Phalacrocorax carunculatus (Gmelin).*Pelecanus carunculatus* Gmelin, Syst. Nat., 576, 1789.

Type locality: Queen Charlotte Sound.

Six specimens from a breeding station at the entrance to Queen Charlotte Sound, collected on 2nd December, 1931, by Mr. D. Perano, have been examined and the following measurements taken in the flesh:—

| Number and Sex. | | | Wing. | Tail. | Tarsus. | Outer Toe and Claw. | Culmen. |
|-----------------|-----------|---|-------|-------|---------|---------------------|---------|
| 106.2 | adult | ♀ | 297 | 120 | 65 | 110 | 62 |
| 106.3 | adult | ♂ | 313 | 140 | 70 | 120 | 68 |
| 106.4 | sub-adult | ♂ | 310 | 140 | 70 | 120 | 71 |
| 106.5 | sub-adult | ♂ | 310 | 130 | 70 | 118 | 72 |
| 106.6 | sub-adult | ♀ | 300 | 120 | 68 | 118 | 69 |
| 106.7 | immature | ♂ | 300 | 138 | 62 | 110 | 63 |

Notes on age, plumage and colours of soft parts were made as follows:—

| No. | Age. | Condition of Caruncles. | Naked Skin of Face. | Feet. |
|-------|-----------|--------------------------------------|---|--|
| 106.7 | Immature | No caruncles | Dull fleshy pink, including eyelids | Fleshy white with tinge of pink |
| 106.6 | Sub-adult | No caruncles | Eyelid slate blue, face dull red brown, chin dary slate grey | As above |
| 106.5 | Sub-adult | No caruncles | As last. A tinge of yellow at gape | As above |
| 106.4 | Sub-adult | Very small | Skin of face red-brown. Eyelids slate blue. Gular pouch dark slate grey | As above |
| 106.2 | Adult | Well developed crimson and orange | As in last, but colours deeper. | As above, slightly stained with brown on webs and joints |
| 106.3 | Adult | As last, but caruncled patch smaller | As last | As above |

The specimens having been frozen, flesh colours given may not be quite accurate. The series illustrates the successive changes of plumage with age. No. 106.7 is a bird of the year and shows no sign of moult, which is in progress in all the others.

The abrasion and fading to which a first plumage is quickly liable is much in evidence. The general disposition of coloured and white plumage is similar to the adult (Pl. 27), but the upper parts are dull brown tinged faintly with green on wings and rump, and faded almost white on lesser wing coverts, scapulars, mid-dorsal region and tail. With the exception of the tail these are areas that subsequently carry pure white feathers in the adult plumage.

In No. 106.6, undergoing a renewal of plumage, bronze green feathers are replacing the brown. The faded brown primaries and lesser coverts of the first plumage are still present, but amongst the latter some pure white feathers of the alar bar are beginning to show. A few white feathers have also appeared mid-dorsally. The colours of the naked skin of the face, described in the table above, are rather duller than those of fully adult birds.

No. 106.2, an adult female, has the brightest plumage and the largest patch of caruncles in the series. The bronze green of the upper parts is strongly metallic, with a tinge of purple in the feathers of cheek shoulders and scapulars. The white dorsal patch is broken, and does not show when the wings are folded.

No. 106.3, the specimen figured in Plate 27, is an adult male similar in plumage to the last. His smaller caruncles and some non-metallic brown feathers in the forehead indicate that he is a younger bird than 106.2.

A feature of the plumage of all the adult and sub-adult birds, traceable even in the youngest, is the presence of irregular patches of white feathers among the outer scapulars, clearly seen in the specimen figured. This character is mentioned by Buller (1876), but appears to have been overlooked by later writers in their descriptions of specific characters. It is, however, the only constant character separating *P. carunculatus* from the series of *P. huttoni* in the museum collection. The large size development of nasal caruncle and colour of upper parts mentioned by Oliver as distinctive can all be matched by some specimens of *P. huttoni* now before me.

Breeding Season: Mr. D. Perano, who collected the birds on 2nd December, informs me that at that time none of the nests were occupied, and that specimen No. 106.7 was the youngest bird he could see. All the adult birds were in moult and not in breeding condition. Captain Fairchild is quoted by Buller (1905, p. 27) as having collected fledglings in the middle of July from the same nesting place, so that a winter breeding season is evidently here the rule, with occasional later laying.

It should be noted that the White Rocks, one of the last known nesting places of this rare and distinctive bird, are situated not in the sheltered waters of Queen Charlotte Sound, but in an exposed situation at the entrance. The birds are poor flyers, and, according to Mr. Perano, when they fly off the rock almost invariably strike the water before getting properly under way.

Food: Examination of the stomach contents of the series described above disclosed portions of crayfish, large crabs, and remains of a small red rock fish. At this season of the year, therefore, food is evidently obtained by diving in the close neighbourhood of the home rocks.

The old sealers' name, "King Shag," still used in the Sounds, should be in more general popular use for this magnificent bird.

Phalacrocorax huttoni Buller.

Phalacrocorax huttoni Buller, Birds N.Z., 2nd Ed., 2, p. 174, 1888.

Type locality: Dunedin.

Particulars and dimensions of specimens in the Auckland Museum collection as follows:—

| No. and Sex. | Locality and Date. | Outer Cul- | | | | |
|--------------|---------------------------------------|------------|-------|---------|------|------|
| | | Wing. | Tail. | Tarsus. | Toe. | men. |
| 1165.1 ♂ | Seal Rks., Foveaux Strait, 21/9/30 | 275 | 125 | 56 | 105 | 56 |
| 1165.2 ♀ | Seal Rks., Foveaux Strait, 21/9/30 | 283 | 110 | 57 | 103 | 51 |
| 1165.3 ♀ | Seal Rks., Foveaux Strait, 21/9/30 | 285 | 109 | 58 | 105 | 54 |
| 1165.4 ♀ | Seal Rks., Foveaux Strait, 21/9/30 | 286 | 117 | 57 | 103 | 55 |
| 1165.5 ♀ | Stewart Island | 301 | 121 | 55 | 110 | 61 |
| 1165.6 ♀ | "Otago," July, 1896 | 277 | 122 | 59 | 101 | 51 |
| 1165.7 ♂ | "Otago," July, 1896 | 260 | 116 | 57 | 106 | 53 |
| 1165.8 ♂ | Cape Saunders, Otago | 330 | 140 | 68 | 120 | 63 |

The flesh colours have not been noted, but in dried skins they appear similar to *P. carunculatus*. All are adult birds and show alar bars of white. In the matter of dorsal patches, crests and caruncles, they show some variation, indicated in the following table:—

| No. and Sex. | Carunculation. | Dorsal Patch. | Crest. |
|--------------|--------------------------|----------------------|----------------------------|
| 1165.1 | Small red papillae | Irregular and broken | Small |
| 1165.2 | Small orange papillae | Absent | Medium |
| 1165.3 | Small red papillae | Absent | Small |
| 1165.4 | None visible | Absent | Small |
| 1165.5 | Cluster of red papillae | 35mm. wide | Small |
| 1165.6 | None visible | One white feather | Medium |
| 1165.7 | None visible | Irregular | Medium |
| 1165.8 | Large cluster orange red | Narrow | Conspicuous. 55mm. long |

Number 1165.8 is a remarkable bird, reaching the average size of *P. carunculatus* in all dimensions, and differing in appearance from that species only in his conspicuous crest and absence of white scapulars. His cluster of caruncles does not equal the strong development found in some specimens of *P. carunculatus*,

but it is a difference of degree only, and not sufficient to justify the artificial separation of these two species into sections arbitrarily designated "carunculated" and "non-carunculated," as suggested by Hutton (1905, p. 276) and Oliver (1930, p. 191). The series representing these two species show indications of close affinity, and a subsequent reviewer with enough material to group all sub-antarctic shags in a classification indicating relationships may well find it possible to relate these two sub-specifically.

In general it may be said that *P. huttoni* differs from *P. carunculatus* in its average smaller size, tendency to bluish purple on thighs instead of bluish green (this is not uniform), development of a crest, weaker carunculation, and absence of white scapular patches, but that in all or any of these characters except the last, odd specimens may approximate to the condition of *P. carunculatus*. It is noteworthy that the bird number 1165.8 described as resembling *P. carunculatus* was collected at the point (Cape Saunders) where the range of *P. huttoni* approaches nearest to the range of *P. carunculatus* (Marlborough Sounds).

Breeding season: A young bird in the collection (No. 1165.9) was taken at Cape Saunders in November, 1885. It is fully fledged except on neck and throat, where the down is thick, and wisps of down on breast and flanks.

Fledgling plumage: The thick secondary down covering the neck and throat of the specimen (No. 1165.9) just mentioned is smoky brown in colour, with tufts and filoplumes of white interspersed both back and front. The wisps of down still adhering to the underparts are mainly brown; a few are white. This is almost exactly the condition of a fledgling, *P. georgicus*, seven weeks old, described and figured by Murphy (1916, pp. 38-39). It also agrees with Buller's description of a fledgling *P. carunculatus* (1888, II., p. 155). Moreover, a fledgling of *P. onslowi*, described later in this paper, is of apparently the same age, and is exactly similar except in size. Oliver's description of the nestling of *P. huttoni* (1930, p. 191), "covered with black down, sometimes white on the underparts," could not be accurately applied to the condition here described. The fresh feathers of the first teleoptile plumage are brown tinged with dull green on mantle, secondaries, rump and thighs.

***Phalacrocorax chalconotus* (Gray).**

Graculus chalconotus Gray, Zool. Erebus and Terror, Birds, 20, 1845.

Type locality: Otago.

Dimensions of specimens in the Auckland Museum are as follows:—

| No. and Sex. | Locality and Date. | Outer Cul- | | | | |
|---------------|---------------------------------------|------------|-------|---------|------|------|
| | | Wing. | Tail. | Tarsus. | Toe. | men. |
| 99.1 immature | Otago | 300 | 145 | 56 | 106 | 57 |
| 99.2 ad. ♀ | Otago Heads, June, 1886 | 311 | 132 | 64 | 118 | 69 |
| 99.4 ad. ♀ | Green Island, Otago | 306 | 142 | 60 | 117 | 65 |
| 99.5 ad. ♂ | Otago, 31/7/96 | 275 | 125 | 62 | 102 | 58 |
| 99.6 ad. | Otago Heads, June, 1886 | 300 | 132 | 62 | 103 | 65 |
| 99.7 ad. ♀ | Dunedin, July, 1896 | 285 | 120 | 60 | 104 | 58 |
| 99.8 ad. ♂ | Seal Rks., Foveaux Strait, 21/9/30 | 295 | 115* | 58 | 111 | 58 |
| 99.9 ad. ♀ | Seal Rks., Foveaux Strait, 21/9/30 | 295 | 110* | 57 | 106 | 57 |
| 99.10 ad. ♂ | Seal Rks., Foveaux Strait, 21/9/30 | 285 | 113* | 56 | 98 | 53 |
| 99.11 ad. | Seal Rks., Foveaux Strait, 21/9/30 | 280 | 105* | 54 | 104 | 54 |

*The birds from Seal Rocks, taken when the breeding season was already well advanced, have tails much shortened through abrasion.

Condition of crests and extent of carunculation is as follows:—

| | | |
|----------|---------------------|---|
| No. 99.2 | Crest long (45 mm.) | Conspicuous cluster of small red caruncles. |
| 99.4 | No crest | Cluster of small red papillae. |
| 99.5 | Medium crest | No papillae visible. |
| 99.6 | Crest long | A few yellow caruncles. |
| 99.7 | Small crest | No papillae visible. |
| 99.8 | Small crest | No papillae visible. |
| 99.9 | Medium crest | A few small yellow papillae. |
| 99.10 | Small crest | A few small yellow papillae. |
| 99.11 | No crest | A few small red papillae. |

The whole series is remarkably uniform in plumage and shows no variation from the conditions already well described in the literature of the species. Colours of soft parts as far as can be judged by comparing dried specimens are exactly as in *P. huttoni*. A further correspondence between these two species is to be noted in the fact that in both the largest birds and birds showing distinct carunculation, are from Otago Peninsula, the most northerly point in their co-extensive range. It is to be remarked also that the two birds in the most perfect plumage, with long crests, and visible though small clusters of caruncles, were collected at Otago Heads in the mid-winter month of June.

Phalacrocorax onslowi Forbes.

Phalacrocorax onslowi Forbes, Ibis 1893, p. 533.

Phalacrocorax rothschildi Forbes, Ibis, 1893, p. 537.

Type locality: Chatham Islands.

There is only one specimen in the Auckland Museum collection, but I have been able, by courtesy of Professor Speight, to

examine four more from Canterbury Museum, including two fledglings. The older birds give the following dimensions:—

| Number and Sex. | Date. | Outer | | | | |
|----------------------------|----------|-------|-------|---------|------|---------|
| | | Wing. | Tail. | Tarsus. | Toe. | Culmen. |
| Auck Mus. 163.1 adult | — | 285 | 118 | 55 | 109 | 52 |
| Cant. Mus. 01172.13 ad. ♀ | 22/12/23 | 278 | 115 | 56 | 112 | 56 |
| Cant. Mus. 01172.12 immat. | 22/12/23 | 274 | 133 | 60 | 118 | 54 |

All are from Chatham Islands. No. 01172.12 is fully fledged except for wisps of down still adhering to throat and fore-neck. Two other fledglings (Nos. 01172.9 and 01172.10) are younger and still densely clothed on throat and pileum with thick smoky brown down, in which are mixed soft filoplumes of white. In all three young birds the first plumage visible is coloured as follows: Upper parts dull brown tinged with green except on the lesser wing coverts, which are pale brown. Rump and thighs a mixture of dark brown and blackish green. Underparts white, as in adult. Colours of the soft parts at all stages have been given by Archey and Lindsay (1924, p. 192).

It should be noted that the green tinge in the fresh juvenile plumage of all sub-antarctic shags is subject to such rapid fading that a bird may appear entirely brown above, without a trace of green, just before its first moult.

That the white dorsal patch may be post-nuptial in adults is suggested by the fact that it is absent in the glossy crested adult (No. 163.1, Auckland Museum), but fairly well developed in the December adult (No. 01172.13, Canterbury Museum), which has lost its crest. An unpublished photograph of a group taken in March shows a number of birds with the dorsal patch. An immature bird in the collection of Mr. A. C. O'Connor has the brown on both sides of the neck, almost meeting on the fore-neck. The continuity of white from chin to tail is, however, not actually broken.

Since writing the above I have received on loan from the Dominion Museum, Wellington, by courtesy of Mr. W. R. B. Oliver, the bird that is the basis of his remark (Oliver 1930, p. 189), under heading "Immature," that "the dark colour may extend across the neck even in birds in which the head is steel blue." This bird is labelled "Chatham Islands," without further data. It does not show any signs of immaturity, having, indeed, glossy adult plumage and the well-developed crest that is pre-nuptial in all blue-eyed shags that have a crest at all. The steel blue colour extends in a narrow (15 mm.) band across the fore-neck as in *P. campbelli*, with scattered white feathers down the mid-line. It has a broad white alar bar, no dorsal patch and no sign of carunculation; the loreal space being thinly feathered. Its dimensions are—wing 267, tail 105, tarsus 55, outer toe 101, bill 47 mm.

This specimen introduces a disturbing element into discussions of the status of *P. onslowi*. If the locality given on the label is correct, we have to consider alternative explanations.

- (1) That two species of blue-eyed shags inhabit the Chatham Islands, as Forbes evidently thought (1893, p. 539), but failed to make clear. This bird exhibits some of the characters of both *P. campbelli* and *P. colensoi*, and is nearest to the former.
- (2) That the species inhabiting Chatham Islands is so variable in size and plumage that the specific distinction between *P. onslowi* and other shags in the adjacent area breaks down.

In the absence of supporting data it is safer to assume that a mistake has been made in labelling this specimen "Chatham Islands."*

***Phalacrocorax campbelli* (Filhol).**

Urile campbelli Filhol, Bull. Soc. Philom., 2, 132, 1878.

Type locality: Campbell Island.

There is only one labelled skin in the collection, that of a male bird collected by A. Reischek at Campbell Island on 30th January, 1888. The plumage is dull and does not appear to be fully adult. The glossy dark plumage of head, neck all round, rump and thighs, is dull indigo, greenish on the side of the head, oil green on shoulders and scapulars. The only sign of white on the lesser wing coverts is a solitary feather on the right wing. Of the feathers on the gular pouch, the first few, from the apex of the strip for a distance of 6 millimetres are dark; the rest, extending over the throat, are white. A solitary dark feather also shows in the breast an inch or so below the dark patch of the foreneck. Colours of soft parts are not determinable. Dimensions—wing 272, tail 114, tarsus 57, outer toe 96, bill 50 millimetres.

Another bird undoubtedly of this species is unfortunately without any data whatsoever. It is remarkable for the brilliant lustre of its dark plumage and bushy crest, of which the longest feathers are 60 mm. The white alar bar is narrow, and there is no sign of dorsal patch. Dimensions—wing 270, tail 120, tarsus 52, outer toe 94, bill 48.

Genus *STICTOCARBO* Bonaparte.

***Stictocarbo punctatus* (Sparrman).**

Pelecanus punctatus Sparrman, Mus. Carls., fasc. 1, No. X., 1786.

Type locality: Queen Charlotte Sound.

*Since the above went to press Mr. Oliver has informed me that the specimen has almost certainly been wrongly labelled.

Material in collection of Auckland Museum:—

| No. | Sex. | Locality. | Wing. | Tail. | Tarsus. | Outer Toe. | Bill. |
|-------|--------|----------------|-------|-------|---------|---------------|-------|
| 96.1 | ad. | Rakino Island | 235 | 83 | 51 | 91 | 63.5 |
| 96.3 | ad. ♀ | Whangaparaoa | 230 | 80 | 50 | 83 | 60 |
| 96.4 | ad. | Rakino Island | 242 | 93 | 53 | 88 | 62 |
| 96.5 | juv. | Bay of Islands | 234 | 85 | 54 | 84 | 64 |
| 96.70 | juv. ♀ | Kohimarama | 239 | 82 | 55 | 87 | 63.5 |
| 96.71 | juv. ♀ | Thames | 230 | 73 | 55 | 82 | 62 |
| 96.72 | ad. | Waiheke | 242 | 87 | 52 | 88 | 62 |

With one exception (No. 96.5) the specimens listed above are all from the Hauraki Gulf and indicate a uniformity of size and plumage sequences in birds from this area. In the first plumage succeeding the down the upper parts and thighs are ashy brown and the underparts ashy white, the shades merging on the neck. At this stage small filoplumes may be present on neck and thighs, and the feathers of the mantle are dark-spotted at the tips. After the next moult more pronounced spots appear at the tips of upper wing coverts and scapulars, as well as on the mantle, greenish black feathers appear on crown, hind neck and throat, and across the lower ventral surface in line with the thighs, which by this time are oil green, as are also the rump and back. The stripe down the side of the neck remains mottled ashy brown and white until the assumption of the nuptial ornaments consisting of frontal and occipital crests, and extensive series of elongated white feathers of fine texture. These latter overlie the shorter feathers of the sides of the neck and meet on the nape like an erect mane. They also appear more sparsely on the dark foreneck and lower back and thighs. These sporadic white feathers appear to be too highly specialised in structure to come under the accepted definition of filoplumes, being fully equipped with barbs to the base of the shaft. True filoplumes are also present in this nuptial plumage, as in the first teleoptile plumage of the young bird.

The progressive extermination of this species in the Hauraki Gulf has been rapid during the last few years, and the legal protection now afforded by an Order-in-Council published in the N.Z. Gazette of 9th January, 1931, has come none too soon. In 1910 nesting colonies occupied permanent stations in suitable headlands of the islands Tiritiri, the Noises, Rakino, Waiheke, Shag Rock, and islets off Coromandel. More than half of these were deserted by 1920, and others have dwindled rapidly. One has been observed by the writer at intervals since 1923, in which year 100 birds were seen there. In 1925 only 40 remained, in 1928 only 25, and in 1931 none at all. The only colony left on the western side of the Gulf at the present time is in a narrow tunnel that pierces a small islet, and from which the birds rarely emerge. On the west coast of the North Island at Te Henga and Oaia islet are inaccessible colonies of Spotted Shags, but whether of *S. punctatus* or another form I am unable to state.

The similarity between this bird and *Phalacrocorax gaimardi* of Peru extends to the high pitched chirping note exactly like that of a young sparrow. This has been remarked on in the case of the Peruvian bird by Coker (1919, p. 481). Another point in common, a feature observable in the living bird, but disappearing after death, is the beaded surface of the fleshy ring surrounding the eye. Coker notes "16 blue beads surrounding the eye" in *P. gaimardi*. My notes mention a double row of beads of opal blue in a living specimen of *S. punctatus*. Beyond this ring the facial and gular skin is viridine green, paler on the throat. Bill horny white with a dull brown stain on the ridge, irides opal brown, feet *Caryta* yellow. These colour notes were taken from a second year bird, sexually mature, but not in nuptial plumage.

Breeding habits: Oliver (1930, p. 199) remarks on the evidence of nuptial plumage in Canterbury in August, and his own finding of eggs at Waiheke in January. To this may be added the fact that the cavern-dwelling colony that alone now represents the species on the western side of Hauraki Gulf has for some years past been breeding in mid-winter. Full nuptial plumage is present in most of the birds in May, by the end of which month in 1932 about twenty new nests of green *Mesembryanthemum australe* had been built up, but no eggs laid.

Food: My only records of stomach contents refer to two examples containing respectively reddish crustacean remains (W. Coast, January) and adult anchovies, *Engraulis australis*, (Hauraki Gulf, May).

Stictocarbo featherstoni (Buller).

Phalacrocorax featherstoni Buller, Ibis, 1873, p. 90.

Type locality: Chatham Islands.

Material examined:—

| Collection and Number. | Sex. | Locality. | Date. | Outer | | | | |
|------------------------|------|-------------|-------|-------|-------|---------|------|-------|
| | | | | Wing. | Tail. | Tarsus. | Toe. | Bill. |
| Auck. Mus. 97.1 | ♂ | Chatham Is. | — | 236 | 95 | 51 | 77 | 52.5 |
| Auck. Mus. 97.2 | ♀ | Chatham Is. | — | 230 | 98 | 44 | 78 | 47 |
| Auck. Mus. 97.3 | ♂ | Chatham Is. | — | 242 | 96.5 | 48 | 88 | 55 |
| Auck. Mus. 97.4 | | Chatham Is. | — | 227 | 90 | 50 | 81 | 49 |

The specimens here listed are all adult and in full crest. A longer bill in the male is indicated by the measurements.

Stictocarbo steadi Oliver.

Stictocarbo steadi Oliver, Trans. N.Z. Inst., 61, 138, 1930.

Type locality: Otago.

The only specimen in the collection of the Auckland Museum is a female collected at Stewart Island in December by Mr. E. F. Stead. It is not in breeding plumage, and possibly not fully mature, as the dark throat is flecked with pale grey, and the

white neck stripe is also broken with darker feathers. It has no crests. The neutral grey of the under-parts corresponds to the shade found in *S. featherstoni*, that is, the light neutral grey of Ridgway's Standards, rather than to the pale neutral grey found in *S. punctatus*. The shoulders, mantle, and upper surface of the wings are greyish brown glossed with green, identical in this respect also with *S. featherstoni*.

In a living or freshly killed specimen the opal blue skin surrounding the eye is beaded, sixteen such "beads" being counted in the bird described above. Its dimensions are: Wing 234 mm., tail 85, tarsus 51, outer toe 84, bill 55.

Except for the narrow white neck stripe which links it to *S. punctatus*, the plumage of this single specimen shows closer affinities with *S. featherstoni* than with the northern series of *S. punctatus* available for comparison.

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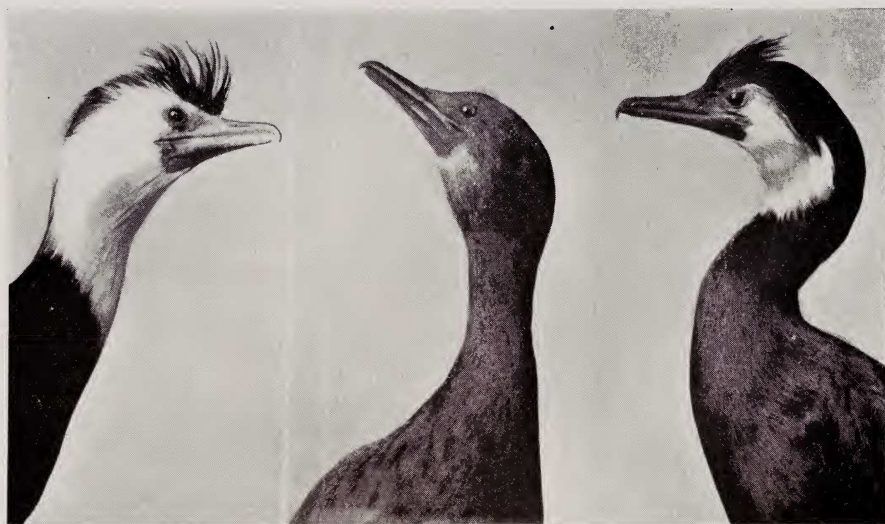


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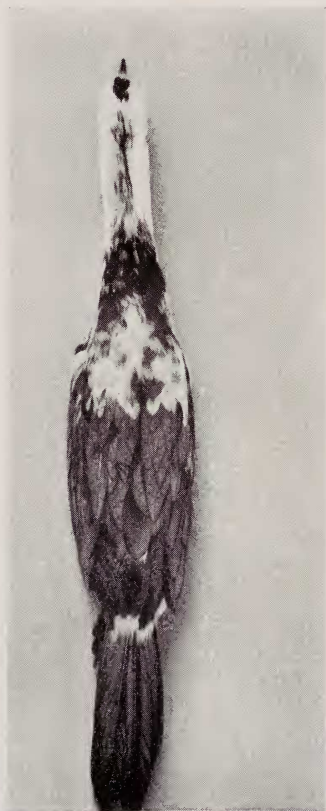


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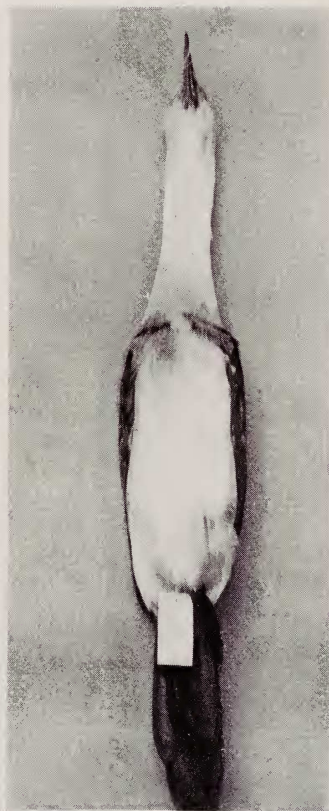
Fig. 1. Head of *Phalacrocorax carbo*.
Fig. 2. Fledgling *Phalacrocorax ater*.



1



2



3

Fig. 1. Left: Adult *P. brevirostris*. Centre: Immature *P. brevirostris*.
Right: Adult *P. brevirostris*.
Fig. 2. Dorsal view of abnormal *P. brevirostris*.
Fig. 3. Ventral view of abnormal *P. brevirostris*.



1

Phalacrocorax carunculatus, showing usual white patches.



2

Phalacrocorax carunculatus.